

MEMORANDUM

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To: Ms. Brenda Ardrey, CGFM
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From: Todd Thalhamer, P.E.

Date: August 29, 2014

RE: Data Package Review for the Month of July and August 2014

As requested, I have reviewed the latest weekly and monthly data packages for July and August 2014 for the Bridgeton Landfill. Temperature, carbon monoxide (CO), and hydrogen all continue to trend upwards. Again, this month I observed some of the highest recorded temperatures in a number of gas extraction wells (GEWs), gas interceptor wells (GIWs), and temperature monitoring probes (TMPs) located in the "neck" and south quarry at the Bridgeton Landfill. Overall, the subsurface fire continues to expand in the South Quarry and into the "neck" area.

Based on the above data and recent CO and temperature readings from GEW-38, GEW-56, GEW-109, and GEW-110, I am surmising the smoldering event may be past the last line of GIWs (GIW-13, GIW-12, GIW-11, GIW-10, GIW-9, and GIW-8). Absent additional CO sampling in the GIWs, the extent and magnitude of this smoldering event cannot be determined. Given the gap in data collection points to the north-northeast of GEW-56R, it is critical that the GIWs be sampled monthly to develop an understanding of the CO gradients being observed in the neck area over time. Additionally, Bridgeton Landfill needs to either submit their field logs containing gas operational information detailing significant issues with GEWS and GIWS or develop an operational gas collection log that provides the current status of each GEW and GIW. Without Bridgeton Landfill staff submitting this data, only limited analysis and projections of the smoldering event can be made, leaving an incomplete picture of the operational effectiveness of the GIW system in containing the smoldering event to the South Quarry and southern portion of the "neck" area.

Recently, Bridgeton Landfill has repeated their claim that the GIWs are effective at containing the smoldering event. Current site activities, settlement, and requests by Bridgeton Landfill staff to once again expand the GIW system by using additional cooling loops in a number of existing GIWs, a request to place flowable fill and to install three (3) new temperature monitoring probes in the neck area in the vicinity of the last row of GIWs appears directly contrary to their claims of effectiveness. My concern is that the heat front/smolder event is shifting and Bridgeton Landfill is reacting to this movement by constructing additional countermeasures in hopes of containing the smoldering event.

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Based on a review of the available July and preliminary August 2014 data, the following are my observations and comments:

Smolder Event Movement Data

All four April, May, June and July SCS Engineer's monthly maps for 2014, show elevated changes in the "neck" area and the South Quarry. For the same period of time, a significant number of CO, hydrogen and initial temperature maximums increased in the "neck" area, along with new locations in the South Quarry. In order to track the progression of the CO/smoldering front and to evaluate whether the GIWs are performing as designed, I analyzed GEW-10, -38, -56R, -109, -110 along with TMP-6, -13, -5 for temperature, CO, and other gas trends. (Note: TMP-13 is not operational, the next closest probe is TMP-11 which is not operational, resulting in a default to TMP-3 for temperature data. Also, TMP-5 is not operational, so the next closest probe is TMP-4.)

Most notably in July 2014, CO increased in GEW-56R from 240 ppm in April, 440 ppm in May, Non-detected in June to 2,220 ppm in July, an 816% change in four months; hydrogen increased from 5% to 35%, a 600% change over the same four months; while the temperature in GEW-56R increased from 91°F to 162°F, a 78% change in the period between 7/16/2014 to 7/28/2014. GEW-109 has increased from 1,500 ppm to 2,600 ppm, a 73% change, and temperature changed from 107°F to 139°F within the months of June and July 2014. Bridgeton Landfill stated in a telephone call with the department that the draft August 2014 CO data reflects CO decreasing in GEW-56R to 1,500 ppm; a temperature of 163°F; and CO decreasing in GEW-109 to 1,700 ppm CO; a temperature of 138°F and CO increasing in GEW-38 to 3,300 ppm with a temperature of 186°F.

TMP-14, which is directly next to GEW-56R, is reporting its highest temperature to date of 186°F at 41 feet below ground's surface (bgs), 172.4°F at 61 ft bgs, 176.4°F at 81 ft bgs, and 178.9°F at 101 ft bgs. The temperature reading at 21 ft bgs in TMP-14 is not being reported due to a malfunction. The last reading at 21 ft bgs was on July 17, 2014, at 180.5°F.

Finally, CO at the flare inlet over the past 45 days has increased from approximately 1,100 ppm to 2,100 ppm, a 90% change. The CO inlet reading is the highest it has been in over a year.

With no operational data being provided, some of the current readings are likely attributable to operational problems in the gas collection system, the absence of data or explanations for such spikes leaves the data to "stand on its own" and be evaluated as submitted. Based on the above trends, the smoldering event is at or just past the GIW system. At this critical juncture, additional data and operational logs are necessary to allow for thorough evaluation of the effectiveness of the GIW system in the neck area to determine the location of the smoldering event.

Temperature Readings in the GEW and GIW for the period July to August 2014

Due to the above normal landfill operating temperatures currently being experienced at Bridgeton Landfill, the following temperature data is highlighted to ensure an understanding of the current events. *Note: According to the Bridgeton Landfill staff not all the GEW temperatures are being reported due to the inherent risk to the sampling technicians from high temperatures, excess pressure, or potential collapse. The plus or minus 20 wells are considered a life safety issue and the temperature data is not collected or reported.*

Neck Area: GEW-38 - temperatures above 185° F
 GEW-11 - temperatures above 190° F
 GIW-10, -1, -2, and -3 temperatures above 185° F
 GIW-14 had the highest to date temperature of 186.8° F at 41ft bgs
 GEW-56R has experienced a significant temperature increase during the two week period identified in July 2014 from 91 °F to 162 °F
 TMP-14 is experiencing at multiple levels bgs some of the highest temperatures to date

North Quarry: GEW-53 and -54 are above the New Source Performance Standards (NSPS) temperature threshold of 131° F for interior gas extraction wells

South Quarry: Temperatures above 185° F in GEW-11, -15, -16R, -18R, -58, -65A, -71, -72RR, -80, -86, -100, and -104
 Temperatures above 185° F in LCS-3C and -3D
 Temperatures above 185° F in SEW- 17R and -63

CO Readings for the period of April 2014 to July 2014

Neck Area: CO in GEW-56R has increased from 240 ppm to 2,220 ppm
 CO in GEW-109 has increased from 1,500 ppm to 2,600 ppm
 CO in GEW-110 has increased from 880 ppm to 1,500 ppm

Note: CO in GEW-56R had its highest reading in Jan. 2014 at 2,900 ppm.

North Quarry: CO was detected in GEW-08 at 35 ppm, GEW-51 at 70 ppm, GEW-53 at 110 ppm, and GEW-55 at 44 ppm. These levels of CO in the North Quarry **are not** of concern at this time but should be closely monitored.

South Quarry: Notable increases in CO (i.e., greater than 1,500 ppm) – GEW-20A, -24A, -25A, -26R, -28R, -34, -35, -36, and -76R
 Notable decreases in CO for wells GEW-77 and -83

Flare Inlet: CO at the flare inlet in the past 45 days has increased from approximately 1,100 ppm to approximately 2,175 ppm.

Oxygen Readings for July 2014

The following components are having oxygen intrusion issues over the NSPS threshold of 5% oxygen for an interior gas extraction well. With the smoldering event expanding, the goal for these components of the gas collection and control system should be to operate at or below 1% oxygen intrusion.

GIW -3, -5, and -8
 GEW -27A, -28R, -61B, -71, -75, -76R, -83, -85, -86, -101, -103, -104, -107, -110, -112, and -116
 PEW -60
 SEW -12A, -32R, -60R, -62R, -64, -67, and -79R

TMP Concerns

Overall the TMPs appear to be indicating the heating event and the smoldering event continues to move towards the surface. One can also take the approach that the waste mass is settling into the reaction zone below ground, either way the smoldering event can surface through the waste or the waste can collapse downwards or be consumed by the smoldering event. The outcome from either view is unacceptable and has negative outcomes for the community. The goal has been and remains preventing daylighting of the below ground smoldering event, so that visible flames and smoke are never generated by the permitted facility and allowed to extend beyond the property boundary.

Some of the highest temperatures to date have been recorded in July 2014 in the neck area, specifically TMP-2, TMP-8, TMP-9, TMP-12 and TMP-14. TMP-8 and 9 are both experiencing significant temperatures above 250° F. The temperatures at these monitoring locations have continued to increase below ground.

With the number of non-functioning temperature points (e.g., 89 out of 133 probes) in the TMP monitoring system as of August 2014, additional TMPs should be constructed to replace non-functional TMPs to track the heat front. Based on location and functionality TMPs -3, -4, -5, -6, -11, -12, -13 should be replaced. Without a properly functioning TMP system, Bridgeton Landfill staff and the department cannot adequately track the heat front and examine temperature trends to determine if the GIW system is functioning, as designed. See Table 1 for further information.

Table 1. Temperature Monitoring Probes (TMPs) at
Bridgeton Landfill "Neck" Area

	# Probes	# Functional	% Failed	Location
Probe				
TMP-1	7	5	29%	North Quarry Side
TMP-2	11	9	18%	North Quarry Side
TMP-3	13	6	54%	North Quarry Side
TMP-4	2	1	50%	North Quarry Side
TMP-5	11	0	100%	North Quarry Side
TMP-6	11	3	73%	North Quarry Side
TMP-7	12	0	100%	South Quarry Side
TMP-8	13	3	77%	South Quarry Side
TMP-9	5	1	80%	South Quarry Side
TMP-10	7	7	0%	North Quarry Side
TMP-11	11	0	100%	North Quarry Side
TMP-12	10	3	70%	North Quarry Side
TMP-13	10	0	100%	North Quarry Side
TMP-14	10	6	40%	North Quarry Side
Totals	133	44	67%	

Summary

While the Bridgeton Landfill team may evaluate the data on daily, weekly, and monthly basis, the submitted data must be transparent with operational issues reported so an independent review of the GIW system can be performed. This ability to determine if the smoldering event is contained to the "neck" is based on having the proper data. The community depends on the department to independently evaluate, confirm, and verify the data submitted by Bridgeton Landfill is complete and accurate.

Recommendations from Data Analysis

1. Immediately, approve the experimental cooling loop plan and new TMPs for the "neck" area. All methods to contain this smoldering event in the "neck" should be applied.
2. Request Bridgeton Landfill sample the GIW system monthly for CO. This data is critical in determining the effectiveness of the GIW system including the new cooling loops and for projecting/predicting the movement of the smoldering event at or through the "neck." To reduce CO sampling cost to the Bridgeton Landfill, I would recommend exchanging 13 post smoldering event GEW in the South Quarry for 13 GIW in the "neck."
3. DNR should be provided the chain-of-custody forms and the laboratory data sheets showing the raw data and quality control data for CO testing. This will allow for validation of CO data and ensure all samples were analyzed within the recommended holding times.
4. Request Bridgeton Landfill replace TMPs -3, -4, -5, -6, -11, -12, -13.